

AS
CS
--31. The pleated filter cartridge of claim 23 wherein the at least one sheet of filter material is a single sheet of the filter material and such sheet has a thickness of less than about 0.15 mm, whereby the total thickness of the filter material is less than about 0.15 mm.--

Remarks

The Office Action and cited references have been reviewed with care in preparation for this amendment and response. Applicants' claims set forth an important advance in the field of annular pleated filter cartridges for liquid filtration.

More specifically, the claims as presented patentably distinguish applicants' invention over the prior art, including the prior art cited and relied upon by the Examiner. Set forth below are careful explanations of the patentability of the claimed invention, and specific supporting evidence in the form of the attached Declaration of Dr. Ernest Mayer, a leading expert. By such arguments and evidence, applicants establish that the claimed invention satisfies conditions of patentability, including in particular as set forth in 35 USC §103. Favorable review and action are requested.

Applicants now turn to the particular points raised by the Examiner in the Office Action of June 28, 2001.

The Examiner objected to applicants' incorporation by reference in one portion of the specification. Such incorporation by reference is unnecessary and amendment has now been made to the paragraph spanning pages 8 and 9 of the specification in order to eliminate such incorporation by reference. Thus, the basis for objection has been removed.

Claims 14-17 and 23-27 (sic: 24-27) were rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention. More specifically, the Examiner has pointed out that the limitation "the lower end of the softening temperature of the high-density polyethylene filter material," as recited in claim 14 (lines 2-3) and in claim 24 (lines 2-3), has an insufficient antecedent basis. Claims 14 and 24 have been amended to overcome this rejection.

More specifically, claims 14 and 24 were each amended to properly introduce the fact that "the high-density polyethylene filter material has a softening temperature range," so that the comparative reference later in each of these claims has a proper antecedent basis. Applicants note that it is well known, of course, that high-density polyethylene materials have a softening temperature range. This curative amendment also applies to dependent claims 15-17 and 25-27.

Claims 1-29 were rejected under 35 USC 103(a) as unpatentable over the Ashelin et al. patent in view of the product pamphlet entitled "Dupont TYVEK -- The Medium That Fits a Variety of Filtration Needs" (hereafter referred to for convenience as "the Dupont pamphlet"). Applicants submit that the pending claims set forth an invention which is *not* obvious under 35 USC 103(a); the claimed invention is an important and unobvious advance in the particular field of non-woven annular pleated filter cartridges for liquid filtration apparatus.

In this connection, it is critically important to recognize that the field of annular pleated non-woven filter cartridges for liquid filtration apparatus not only involves non-woven filters in a specific form (annular pleated filter cartridges) unlike that of other liquid filter forms (e.g., flat sheet systems), but that annular pleated non-woven filter cartridges present specific *problems and concerns* which are unique -- and which, as shown in detail below, teach away from the claimed invention.

The specific problems and concerns relate to perceptions by those of ordinary skill in the art of what kind of material is necessary in order for the ends of the annular pleated arrangements to appropriately seal in the endcaps, in order to reliably avoid imperfect endcap sealing and the resulting unintended by-pass of the filter. More specifically, annular pleated non-woven filter cartridges of the prior art have non-woven filter elements that are *thicker* than the non-woven filter elements of the claimed annular pleated filter cartridges; and, given the highly flexible nature of the particular non-woven filter material used in the claimed invention (i.e., the Tyvek material recited in the claims), which is different from and thinner than the non-wovens of prior art annular pleated non-woven filter cartridges, persons of ordinary skill in the art, because of their knowledge of such problems and concerns, would reject the idea on which this invention is based as unrealistic or unfeasible. Likewise, to persons of ordinary skill in the art, the nature of

the Tyvek material recited in the claims is such that it would not be thought reliably capable of successful lengthwise bonding, as is necessary, and use of such material is contra-indicated.

The Declaration of Ernest Mayer, who is a Dupont expert, particularly paragraphs 10 and 12-17 of the Mayer declaration, set forth facts showing perceptions of those of ordinary skill in the art as such perceptions would relate to the obviousness issue in this matter. This is strong evidence for the non-obviousness of the claimed invention. Furthermore, the particular annular pleated non-woven filter cartridge of applicant's invention in fact provides important, unexpected functional advantages over prior annular pleated non-woven filter cartridges for liquid filtration. These advantages will be referenced later in this response.

The Examiner should note that applicants acknowledged, as set forth in the specification of the application, that the prior art includes annular pleated filter liquid filtration cartridges involving other filter materials, particularly other non-wovens. At page 2, lines 5-7, the specification refers to the non-woven polypropylene, nylon and various polyesters of the prior art, and notes that they are thicker than the non-wovens used in applicants' annular pleated non-woven filter cartridge invention. Applicants also have acknowledged from the outset, including in the specification of the application itself, that the prior art includes the Tyvek material referred to in the Dupont pamphlet, but in liquid filtration applications other than annular pleated filter cartridges. As indicated above, however, the existence of such two types of prior art does *not* render obvious the particular annular pleated non-woven filter cartridges of applicants' invention.

Prior to the instant invention, annular pleated non-woven filter cartridges had not used Tyvek materials (see Mayer declaration, paragraph 12); the liquid filter applications of such materials were limited to other forms, including flat sheets and other non-annular forms. The Dupont pamphlet, though it makes general assertions on the "wide variety" of applications, does *not* refer to annular pleated filter cartridges. As already noted, persons of ordinary skill in the art, because of the knowledge of well-known technical considerations tending to make such annular pleated non-woven filter cartridges problematic and contra-indicated, would regard such application as unrealistic or unfeasible. Against this background, applicants made an invention

with very important and unexpected advantages over prior annular pleated non-woven filter liquid filtration cartridges.

Before touching on the advantages of the present invention, a number of points should be made concerning the annular pleated filter cartridge of the prior Ashelin et al. patent and the non-pertinence of the Ashelin et al. patent to the particular annular pleated non-woven filter liquid filtration cartridge of applicants' invention. The most significant points of distinction and non-pertinence are as follows:

- The Ashelin et al. filter is, as pointed out below, a membrane or film filter for removal of particles of a *radically smaller size range* than the particles removed by applicants' non-woven filter. The Ashelin et al. patent refers to filtration of particles as small as "about 0.001 microns" (column 1, line 13), and goes on to state that the removal of contaminants of this very small size is "often required in the electronics and pharmaceutical industries." (column 1, lines 12-16) In other words, the Ashelin et al. membrane filter is used to remove not just smaller contaminant particles, but contaminant particles which are *three orders of magnitude less* than the smallest particles for which applicants' non-woven annular pleated filter cartridges are typically used. As pointed out even in the Ashelin et al. patent itself,

...[I]t is well known that filter membranes can be categorized by the particle size of the contaminants which the filter devices are suited to removing.

It is apparent that applicants' high-volume-flow *non-woven* cartridges are in fact in an entirely different category than those of the Ashelin et al. patent, quite apart from other distinctions pointed out below. Both of applicants' independent claims, claims 1 and 23, even indicate that filtration efficiency is measured with respect to 1-2 micron particles -- far away from anything indicated in the Ashelin et al. patent. The teachings of the Ashelin et al. patent are not even pertinent to applicants' claimed invention.

- Unlike the claimed invention, which deals particularly with *non-woven* annular pleated filter cartridges and the particular problems thereof, the Ashelin et al. annular pleated

filter cartridge uses *membranes* or *films* as its filtering material. (See throughout the Ashelin et al. patent, including all of the claims and at column 2, lines 17-18, column 2, lines 38-39, column 1, lines 9 and 10, and elsewhere.) Applicants' invention is an annular pleated filter cartridge using a *non-woven* filter material of a particular type not previously deemed usable in annular pleated filter cartridges -- based on perceptions of non-woven pleated annular filter cartridges which typically have much bulkier and thicker pleats than those using the *non-woven* material of the claimed pleated annular cartridges.

- Unlike applicants' invention, the Ashelin et al. filter material is, as already noted, a composite involving "three or more, e.g., up to as many as nine" (see column 7, line 32) sheets of filtration membrane. This is far more complex and expensive than applicants' claimed invention. The extreme complexity is seen by detailed discussion in the patent of how such "composite" filter material is prepared.¹ Attached as Exhibit A is a copy of Figure 1 of the Ashelin et al. patent with a small portion of the drawing magnified to better show that three laminated membrane layers are involved. In contrast to the Ashelin et al. patent disclosure, applicants' claimed annular pleated filter cartridge has a non-woven filter material, and none of applicants' claims *requires* more than a single layer of such non-woven filter material; applicants' dependent claims 12, 22 and 30-31, in fact, require that there be *only* a "single layer" of the non-woven material. This further dramatizes the non-pertinence of the Ashelin et al. prior art to the claimed invention.

These points showing strong distinctions and emphasizing the non-pertinence of the Ashelin et al. patent are further supported by the Mayer declaration, particularly paragraphs 6-11 and 15. Dr. Mayer provides information on the reference and on perceptions by those of ordinary skill in the art. Such facts are helpful in establishing the non-obviousness of applicants' claimed

¹See, e.g., the extended discussion of fabrication steps for such multi-layered composite running from column 5, line 1 to column 9, line 10, and elsewhere.

invention despite the pre-existence of annular pleated filter cartridges of various kinds and the acknowledged Dupont Tyvek material.

All of the above facts and arguments support the patentability of applicants' independent claims 1 and 23, and therefore likewise support the patentability of the claims which are directly or indirectly dependent on either claim 1 or claim 23. Such dependent claims, of course, have additional limitations which further distinguish over the cited art. Particular reference is made to claims 12, 22 and 30-31 which, unlike what is disclosed in the three to nine layer laminates of the Ashelin et al. patent, require that there be *only* a "single layer" of the non-woven material described in such claims. The requirement of a single layer is advantageous in assuring that the non-woven filter element part of the claimed filter cartridge is extremely thin for a non-woven material, with all the particular advantages such thinness provides.

Applicants' invention provides significant and unexpected advantages over prior annular pleated non-woven filter liquid filtration cartridges.

As already noted, those of ordinary skill in the art would not have expected successful production and operation of such annular pleated filter cartridge. Yet, the claimed annular pleated filter cartridge shows excellent durability and expanded life span improvements; as pointed out on pages 6-7 of the application, life span improvements in excess of 100% are indicated in comparisons involving the filtering of nylon "fines" from an aqueous stream.

Of particular importance is that the claimed invention provides greatly increased surface area for a given size of cartridge, because of a substantial increase in the number of pleats compared to other pleated annular non-woven filter cartridges of like diameter. Stated otherwise, the invention allows major increases in pleat density without the occurrence of flow restrictions of the type associated with pleat tightness, and the major pleat density increases give corresponding major increases in flow and filtering rates. Filter cartridges using other non-woven materials cannot remove solids from fluid streams nearly as efficiently as the claimed invention, and the annular pleated filter cartridges of this invention are found to have excellent dirt-holding capacity. These characteristics enhance efficiency of operation and product life.

**VERSION WITH MARKINGS
TO SHOW CHANGES MADE**

Various specification paragraphs have been rewritten as follows:

The paragraph spanning pages 8 and 9:

--Filter material 30 of pleated filter cartridge 10 is preferably Tyvek® SoloFlo® from DuPont. Such preferred material and the process for material manufacture are described in detail as part of the disclosure of PCT Patent Publication WO98/07905 of DuPont, Wilmington, Delaware. [Such document is incorporated herein by reference.] Acceptable materials include those referred to in Examples 29-32 of such document, and among these the materials of Examples 30-31 are preferred with the material of Example 31 being more preferred. Such material has been used commercially in certain liquid filter forms and functions, but not in annular pleated filter elements.--

Various claims have been rewritten as follows:

--1. (amended) A pleated filter cartridge for removing particulates from liquid, the pleated filter cartridge being of the type including a perforate core, a pair of endcaps, and an annular non-woven filter element around the core formed by substantially axially-parallel pleats of at least one sheet of filter material, the filter element having opposite ends each in sealing engagement with one of the endcaps, characterized in that the filter material is a non-perforated non-woven material of flash-spun plexifilamentary high-density polyethylene fibrils, the filter material having a pressure drop of less than 4 psid at a flow rate of 10 gal/hr and a filtration efficiency of at least 98% of 1-2 micron particulates at a pressure differential of 30 psid.--

--14. (amended) The pleated filter cartridge of claim 13 wherein:

- the high-density polyethylene filter material has a softening temperature range;
- the polyethylene mesh has a softening temperature range lower than the lower end of the softening temperature range of the high-density polyethylene filter material; and
- the polyethylene mesh is tack-point interconnected to the filter material without having compromised the filter material.--

--24. (amended) The annular pleated filter element of claim 23 wherein:

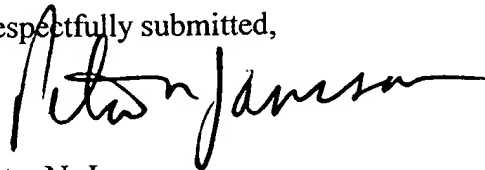
- the high-density polyethylene filter material has a softening temperature range;
- the polyethylene mesh has a softening temperature range lower than the lower end of the softening temperature range of the high-density polyethylene filter material; and
- the polyethylene mesh is tack-point interconnected to the filter material without having compromised the filter material.--

It has further been found that, despite the nature and thinness of the particular Tyvek material used in the claimed filter cartridges and the many pleat folds present in such material, the claimed annular pleated filter cartridge is not susceptible to fiber separation or opening as can occur with other materials -- and avoids such undesirable degradation without the aid of any special chemical binders, calendaring or other non-woven reinforcement measures.

In short, the claimed annular pleated filter cartridge of this invention provides a highly efficient, low-cost, high-flow-volume pleated filter cartridge having significant functional performance improvements over the prior art. The claimed invention is both non-obvious and a particularly useful advance in the art.

Claims 1-31 as now presented are believed to be in condition for allowance. Early favorable action is earnestly solicited. The Examiner is invited to call the undersigned if such would be helpful in resolving any issue which might remain.

Respectfully submitted,



Peter N. Jansson
Registration No. 26,185

Dated: November 28, 2001


Jansson, Shupe & Munger, Ltd.
245 Main Street
Racine, WI 53403-1034
Attorney Docket No. ~~OP~~-102US

EXPRESS LABEL NO. EL741412040US

I hereby certify that this correspondence is being deposited with the United States Postal Service as EXPRESS MAIL in an envelope addressed to: ASSISTANT COMMISSIONER FOR PATENTS, BOX FEE AMENDMENT, P.O. Box 2327, Arlington, VA 22202 on November 28, 2001

Name: Kathy Finder

Signature



11/28/01

Date

Patent Application Serial No. 09/599,269
Applicants: Rose et al.

DECLARATION OF ERNEST MAYER

I, Ernest Mayer, hereby declare as follows:

1. I am Senior Consultant at the DuPont PARSAT Center, Wilmington, Delaware, and have been employed by E.I DuPont de Nemours and Co. in that capacity for many years.

2. I received my B.S. and M.S. degrees in chemical engineering from Columbia University in New York City. I received by Ph.D. degree in chemical engineering from the University of Delaware, Newark, Delaware.

3. This declaration is in support of patent application Serial No. 09/599,269, of Rose et al., entitled "Annular Pleated Filter Cartridge for Liquid Filtration Apparatus," and is for submission by the applicants with an amendment filed by them on or about November 28, 2001. I have spoken with the inventors about the facts and arguments set forth in such amendment.

4. Throughout my career I have dealt with liquid filtration media. I am experienced in the particular field of liquid filtration apparatus of the sort involving annular pleated filter cartridges and am aware of the nature and performance of annular pleated filter cartridges, including those existing before the invention of the above-noted Rose et al. patent application.

5. I have read the principal claim, amended claim 1, as set forth in the aforementioned amendment, which is as follows:

1. A pleated filter cartridge for removing particulates from liquid, the pleated filter cartridge being of the type including a perforate core, a pair of endcaps, and an annular non-woven filter element around the core formed by substantially axially-parallel pleats of at least one sheet of filter material, the filter element having opposite ends each in sealing engagement with one of the endcaps, characterized in that the filter material is a non-perforated non-woven material of flash-spun polyfilamentary high-density polyethylene fibrils, the filter material having a pressure drop of less than 4 psid at a flow rate of 10 gal/hr and a filtration efficiency of at least 98% of 1-2 micron particulates at a pressure differential of 30 psid.

6. I have read Patent No. 5,154,827 (Ashelin et al.) and am familiar with the DuPont pamphlet entitled "Dupont TYVEK -- The Medium That Fits a Variety of Filtration Needs," the references mentioned in the above-noted amendment.

7. My review of the Ashelin et al. patent shows at least two key things which make that reference not at all pertinent to the invention set forth in the Rose et al. patent application.

8. First, the Ashelin et al. filter is a membrane or film filter and is designed for removal of particles of a *radically smaller size range* than the particles removed by Rose et al. invention. More specifically, the reference at column 1, line 13 of the Ashelin et al. patent to filtration of particles as small as "about 0.001 microns" and the indication at column 1, lines 12-16 of the patent that removal of contaminants of this extremely small size is "often required in the electronics and pharmaceutical industries" show clearly that the Ashelin et al. patent is dealing in a different realm; it is not related to annular pleated filter cartridges of the type having *non-woven* filters, which handle high-volume flows. The Ashelin et al. membrane filter is used for removing contaminant particles that are *three orders of magnitude less* than the smallest particles typically dealt with in annular pleated cartridges using non-wovens.

9. Second, while the claimed invention relates to an improvement in annular pleated filter cartridges of the *non-woven* filter type, the Ashelin et al. annular pleated filter cartridge uses what are referred to as *membranes* or *films* as its filtering material, and these are completely different from the subject of the Rose et al. invention. The Ashelin et al. patent membranes are microporous fluorocarbon film materials which have pores intended for capturing extremely tiny particles, and are far from the non-woven material of flash-spun plexifilamentary high-density polyethylene fibrils required in the annular pleated filter cartridges of the Rose et al. invention.

10. Annular pleated filter cartridges using microporous membranes or films are very different than annular pleated filter cartridges using non-wovens, and the Ashelin et al. patent has no bearing on particular problems such as those uniquely associated with annular pleated *non-woven* filter cartridges, which are in a separate category.

11. Another point emphasizing the non-pertinence of the Ashelin et al. filter material is the fact that it has, according to column 7, line 32, "three or more, e.g., up to as many as nine" sheets of filtration membrane in a lamination. Not only is this far more complex and expensive than applicants' claimed invention, but its very complexity emphasizes the non-pertinence of the Ashelin et al. patent. In contrast to the Ashelin et al. patent disclosure, applicants' claimed

annular pleated filter cartridge has a non-woven filter material which does not require multiple layers and often is preferably used in a single layer.

12. Annular pleated non-woven filter cartridges are known to utilize *non-woven* filter materials, such as of polypropylene, nylon and various polyesters, that are significantly thicker and bulkier than the Tyvek material used in the unique annular pleated filter cartridges of the Rose et al. patent application. Until creation of the present invention there were no annular pleated liquid filtration cartridges utilizing Tyvek as the filtration medium.

13. Pleated annular filter cartridges of the type having non-wovens for filtration have particular problems and concerns relating to a difficulty of reliably achieving appropriate sealing of the pleated ends of a pleated non-woven with cartridge endcaps, as is absolutely essential in order to avoid by-pass of the filter. Based on my experience in the art, those skilled in the art of annular pleated non-woven filter cartridges would typically believe that the Tyvek non-woven material referred to in the Rose et al. patent application would not reliably achieve the end sealing relationship that is essential for annular pleated filter cartridges, and would thus turn to other thicker, bulkier non-woven materials. The Tyvek material is highly flexible, and to persons of ordinary skill in the art such thin flexible Tyvek material would not be considered appropriate for annular pleated filter cartridges.

14. The Tyvek material of the annular pleated filter cartridge of the Rose et al. patent application is very thin -- preferably less than about 0.15 mm thick and most preferably less than or equal to about 0.13 mm thick. Given such thinness and the nature of such material, the use of such fragile material for an annular pleated filter cartridge would be contra-indicated to a person of ordinary skill in the art because such material would not be thought reliably capable of successful lengthwise bonding (Tyvek-to-Tyvek) as necessary for formation of an annular pleated filter cartridge for liquid filter use.

15. Because of the particular nature of the Ashelin et al. patent, as noted above, persons of ordinary skill in the art would not combine the disclosure of such patent with knowledge of the Tyvek material in creation of an annular pleated filter cartridge.

16. Nor would persons of ordinary skill in the art, who are aware of the nature of the problems typically associated with manufacture of annular pleated non-woven filter cartridges and made aware of characteristics of the Tyvek material, regard such Tyvek material as a material reasonably usable in connection with creation of an annular pleated non-woven filter cartridge.

17. More specifically, given the low firmness (high flexibility) of such filter material, and the material thinness which exacerbates such flexibility, the ability for such material to be formed successfully into an annular pleated filter cartridge was not and would not have been apparent to persons of ordinary skill in the art.

* * * * *

All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true; such statements were made with the knowledge that willful false statements are punishable by fine or imprisonment or both (18 USC 1001) and jeopardize the validity of the application or any patent issued thereon.

Dr. Ernest Mayer
Ernest Mayer, Ph.D.

Dated: November 28, 2001

enlarged portion

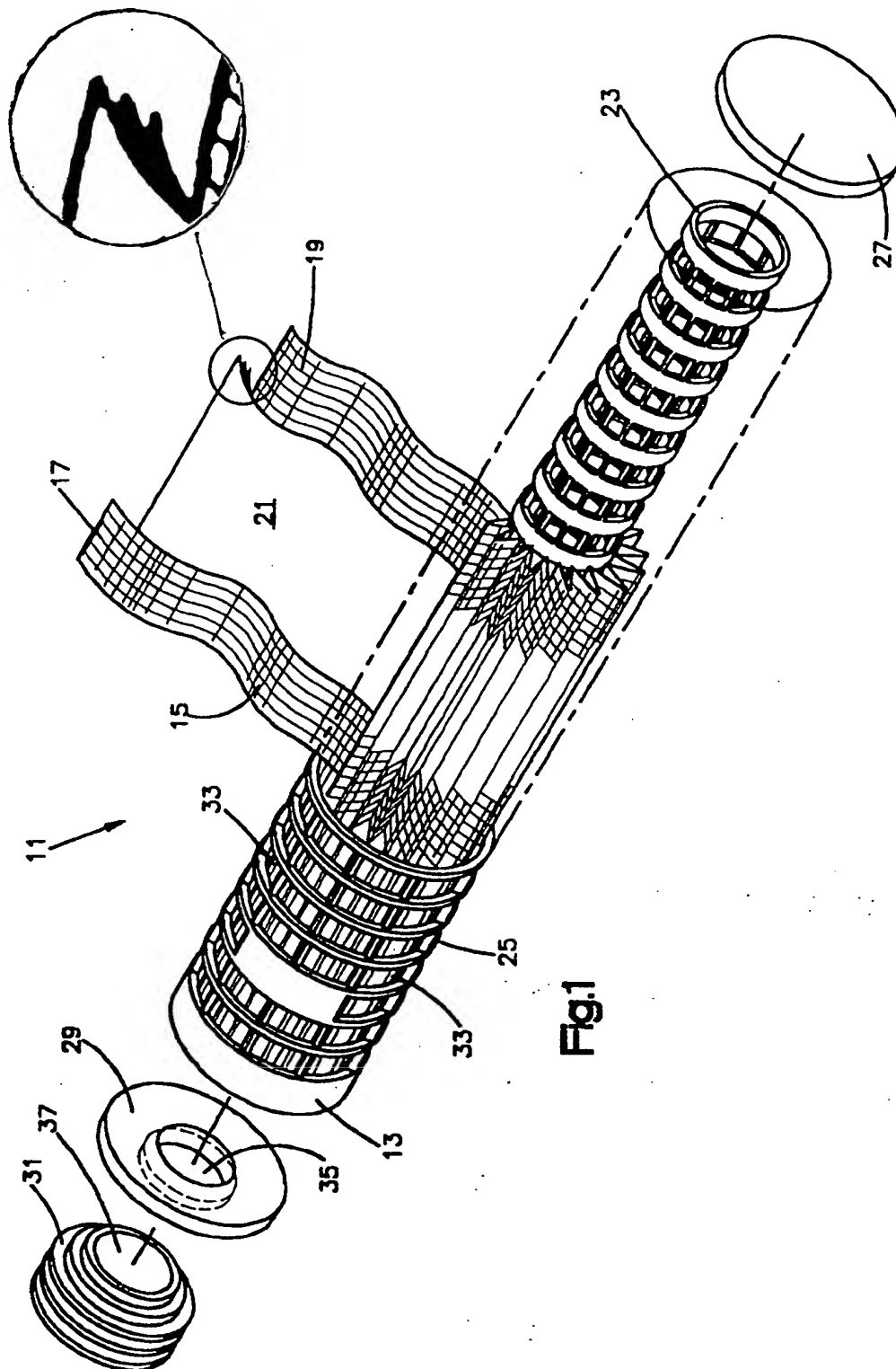


Fig.1

Exhibit A